U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-254 439

# PRELIMINARY STUDY OF SEDIMENT SOURCES IN THE POTOMAC RIVER BASIN, WASHINGTON, D. C. METROPOLITAN AREA

FEDERAL WATER QUALITY ADMINISTRATION

MAY 1970

Item IV
173220

PB 254 439

Surveillance Branch
Middle Atlantic Region
Federal Water Quality Administration
U. S. Department of the Interior
May 1970

# PRELIMINARY STUDY OF SEDIMENT SOURCES IN THE POTOMAC RIVER BASIN

Washington, D. C.

Metropolitan Area

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NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

## INTRODUCTION

Effective utilization and management of land and water resources in a river basin demands a comprehensive knowledge of sediment sources and drainage characteristics. Programs designed to conserve natural resources should be based upon factual information on a number of hydrologic and geologic variables. The nature and extent of sediment movement and the relationship of these phenomena to the environment are among these variables.

The erosion, transport and deposition of fluvial sediment are complex processes and are affected by many climatic, physical and man-made factors. Erosion rates are controlled by the quantity and intensity of precipitation, soil characteristics, topography and the amount of vegetation coverage. The amount of sediment transported by streams is affected by basin size, length, slope, percentage of impervious surface, the size of particles transported and several hydraulic factors such as stream velocity and turbulence. The activities of man in the basin influence significantly the erosion rate, and thus influence the total quantity of sediment transported by streams in the basin.

Recognizing the need for factual information on sedimentation, the Assistant Secretary of the Interior, Water Quality and Research requested that the Federal Water Quality Administration, Middle Atlantic Region, conduct a sediment investigation in the Potomac River Basin between Great Falls and Hallowing Point. The investigation was designed to provide answers to the following questions: (1) What are the sources of the sediment in the Potomac River Basin in the Washington Metropolitan area? (2) What are the relative magnitudes of the sediment loads contributed to the Potomac River and its tributaries below Great Falls from these sources?

This report summarizes the results of an investigation made by the Surveillance Branch to answer the above questions. The investigation, as a result of the time limitation and the magnitude of the problem, was not comprehensive

enough to define the complete erosion transport problem in the Basin but should serve as a preliminary step to more detailed studies of special problems or areas in the Basin.

DESCRIPTION OF STUDY AREA

The study area encompasses Washington, D. C. and the cities of Arlington, and Alexandria, Virginia and includes portions of Fairfax, Montgomery and Prince Georges Counties. Although the cities in the area have experienced tremendous development, portions of the counties remain in a rural state, primarily pasture or woodland. The population of Fairfax county alone has grown from 41,000 in 1940 to 360,000 in 1966 and is expected to reach 1,000,000 before the end of the century.

The study area is located between Great Falls and Hallowing Point and encompasses the entire Potomac River Basin between these points. Land surfaces are less than 500 feet above sea level and are gently rolling. Runoff reaches the Potomac through small streams, which have well defined channels and flood plains covered with a dense growth of brush.

Average annual rainfall exceeds forty (40) inches and is uniformly distributed throughout the year. Three types of storms cause erosion in the area: (1) Summer thunderstorms having short duration but high intensity precipitation; (2) Longer duration but lower intensity precipitation resulting from frontal storms occuring in any season and (3) Rainfall during the period February through April cause high sediment transport conditions.

INVESTIGATION

Because the quantity of suspended sediment is determined from its concentration in a volume of water, a continuous measure of both the sediment concentration and the water discharge is the only precise way to determine suspended sediment discharge. Continuous water discharge at gaging stations is usually

well-defined by present techniques, but the amount of sediment transported is not easily defined and must be determined by individual measurements. Daily sediment measurements, with more frequent observations during periods of flood runoff, are at present the most accurate method for determining sediment discharge. Sediment measurements at regular intervals are useful for making trend analyses and providing a base for checking less accurate studies.

Estimates of sediment loads in this report were determined by relating historical data to current flow records, precipitation and percentage of area under construction, (see Figure 1). An initial reconnaisance flight was conducted to locate and select potential sources of sediment in the Washington, D. C. Metropolitan area on May 8, 1970, (see Figure II). Aerial photographs were then taken of the sites in good weather on May 18, 1970. Also the sites and streams affected were photographed aerially after a rain storm to pinpoint sources and to illustrate graphically the sediment transport problem on May 17. Both true color film and false color infrared film were used and an estimate of annual sediment contribution of each site was determined, (see Table III). A low intensity rainfall of .5 inches was recorded on May 17. The photographs taken after the storm revealed considerable erosion at many of the sites, however, only a fraction of the sediment transported by heavy rainfalls is represented. This method of investigation provides interested agencies and individuals with a visual portrayal of the sediment problem in the Basin but does not define precisely the exact amount of sediment load discharged. Approximately five percent of the existing sources of sediment are represented in the photographs. Aerial photographs did not prove successful in documenting the extent of sediment problems caused by flash floods resulting from high intensity runoff from parking lots, roads, and man-made stream channels. On-site inspection and ground photographs of such sediment

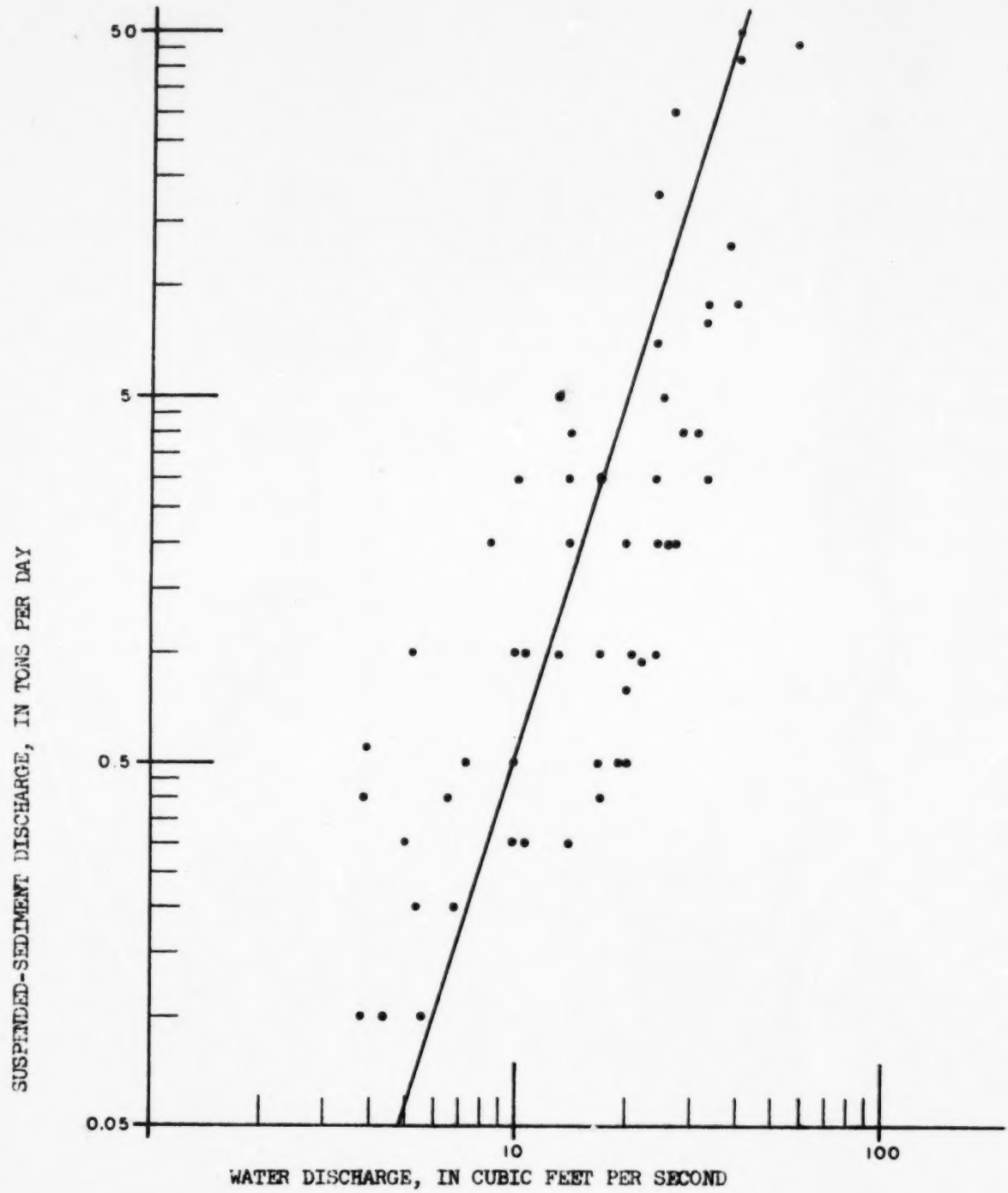


FIGURE 1. Sediment transport curve, N. W. Branch Anacostia River at Colesville, Md. October 1963-September 1964.

**SELECTED SOURCES OF SEDIMENT**

**IN THE POTOMAC RIVER BASIN**

**(Great Falls to Hallowing Point)**

FIGURE II.

SELECTED SOURCES OF SEDIMENT

IN THE POTOMAC RIVER BASIN

(GREAT FALLS TO HALLOWING POINT)

| SITE NO. | NAME OF SOURCE | BUILDER OR OWNER | RECEIVING STREAM | APPROX. AREA |
|---|---|---|---|---|
| 1 | Keene Mill Subd. | Milton Fleisher Dev. Corp. | Pohick Cr. | 107 Acres |
| 2 | Rolling Valley W. Subd. | Thomas Carey, Inc. | Pohick Cr. | 322 Acres |
| 3 | Lake Braddock Subd. | Vienna Dev. Corp. | Pohick Cr. | 428 Acres |
| 4 | Kings Park W. Subd. | Richmarr Const. Corp. | Pohick Cr. | 591 Acres |
| 5 | J. W. Robertson Int. H.S. | Fairfax Co. School Board | Ponick Cr. | 79 Acres |
| 6 | Oakhill Subd. | Vienna Dev. Corp. | Turkey Run | 74 Acres |
| 7 | Sand & Gravel Mining | Virginia Concrete | Dogue Cr. | - |
| 8 | Piscataway Hills Subd. | Unknown | Trib. to Piscataway Cr. | - |
| 9 | Clinton Hills Subd. | State Builders, Inc. | Tinkers Cr. | 50 Acres |
| 10 | Tantallon Subd. | Custom-Built Homes | Swan Cr. | - |
| 11 | Indian Queen E. Subd. | Country Builders, Inc. | Broad Cr. | - |
| 12 | Sand & Gravel Mining | Several Builders | Henson Cr. | - |
| 13 | Sand & Gravel Mining | Virginia Concrete | Backlick Run | - |
| 14 | Seminary Ridge Subd. | Pulte Master Builders | Trib. to Holmes Run | 88 Acres |
| 15 | Anacostia R. Fk. Landfill | Washington San. Sub. Comm. | Anacostia R. | - |
| 16 | Road Work - Rtes. 202 & 704 | State Hwy. Dept. | Beaverdam Br. | - |
| 17 | Ardwick - Ardmore Ind. Subd. | S & S Building Corp | Beaverdam Br. | 10 Acres |
| 18 | I-95 Construction | Several Contractors | Paint Br. | 40 Acres |
| 19 | Valencia Subd. | Larry Lerner | Trib. to Paint Br. | 60 Acres |
| 20 | Sand & Gravel Mining | Capitol Concrete & Pipe | Indian Cr. | - |
| 21 | Wheaton Plaza | | Sligo Br. | - |
| 22 | Stonegate Subd. | Jack Kay | N.W. Anacostia R. | 150 Acres |
| 23 | Layhill Village E. Subd. | Jack Kay | N.W. Anacostia R. | 95 Acres |
| 24 | Strathmore Subd. | Levitt & Sons | Trib. to Rock Cr. | 250 Acres |
| 25 | Manor Lake Subd. | Allen Engineering | N. Br. Rock Cr. | 100 Acres |
| 26 | Westgate Ind. Park | Westgate Corp. | Scott Run | 40 Acres |
| 27 | Shouse Village Subd. | Interstate Const. Corp. | Wolftrap Cr. | 187 Acres |
| 28 | Feline Center | Dept. of Interior | Wolftrap Cr. | - |
| 29 | Trails Subd. | DuPoint Development | Wolftrap Cr. | 72 Acres |
| 30 | Waverly Subd. | Yeonas Land Corp. | Wolftrap Cr. | 88 Acres |



TABLE III.

sources as Sligo Creek in Montgomery County and Turkey Run in Fairfax County proved to be the best method of investigation of this particular problem.

SEDIMENT IN THE BASIN

Most of the annual sediment load in the Potomac River Basin is discharged during a relatively few days each year. During ten percent of the calendar year, streams in the Basin carry approximately 90 percent of their annual sediment load. Although the drainage area in the Washington Metropolitan area is about five percent of the total drainage area in the Potomac Basin, the average sediment discharged represents approximately 28 percent of the total average annual sediment load in the Potomac. An average of approximately 700,000 tons of sediment are transported into the main stem of the Potomac between Great Falls and Hallowing Point annually. An average 2.5 million tons of sediment are estimated to be discharged in the entire Basin annually. About 12 percent of the Potomac Basin sediment load is from the Anacostia River and Rock Creek basins and the area drained by these two tributaries represents about 1.2 percent of the total Potomac Basin. In 1970, the amount of rainfall has been above average and the rate of development has also increased. Considering these facts, it is estimated that the 1970 sediment load contributed by streams in the Washington, D. C. Metropolitan area will be $1\frac{1}{2}$ times the average annual sediment load. This indicates that over one million tons of sediment could possibly be transported to the Potomac this year.

## ESTIMATED ANNUAL DISCHARGE OF SEDIMENT IN STREAMS IN THE POTOMAC RIVER BASIN. (Great Falls to Hallowing Point)

| | Drainage Area (Sq. mi.) | Est. Avg. Annual Sediment Load (tons) | Projected Sediment Load-1970 (tons) | Est. Avg. Daily Discharge (cfs) |
|---|---|---|---|---|
| Difficult Run (near Great Falls.Va.) | 58 | 16,200 | 24,300 | 53.4 |
| Scott Run at mouth | 5.13 | 1,400 | 2,100 | 4.7 |
| Little Falls Branch (near Bethesda,Md.) | 4.1 | 9,500 | 14,200 | 3.17 |
| Pimmit Run at mouth | 3.12 | 1,400 | 3,500 | 7.5 |
| Rock Creek at Sherrill Drive, Washington, D.C. | 62.2 | 99,500 | | 55.3 |
| Rock Creek | 76.5 | 122,400 | 180,000 | 68.6 |
| Sligo Creek at mouth | 13.3 | 21,300 | 32,000 | 11.9 |
| Wolftrap Creek | 7.25 | 2,000 | 3,000 | 6.7 |
| N. W. Branch Anacostia R. at mouth | 53.2 | 102,500 | 155,000 | 54.0 |
| N. W. Branch Anacostia R. (near Colesville, Md.) | 21.3 | 10,000 | | 21.6 |
| N. W. Branch Anacostia R. (near Hyattsville,Md.) | 47.4 | 91,300 | | 39.3 |
| N. E. Branch Anacostia R. at mouth | 75.6 | 80,400 | 120,000 | 78.8 |
| N. E. Branch Anacostia R. (at Riverdale, Md.) | 72.8 | 77,400 | | 75.9 |
| Anacostia River at mouth | 169.9 | 220,000 | 300,000 | 170.3 |
| Oxen Run at mouth | 13.5 | 9,300 | 14,000 | 14.9 |
| Henson Creek at mouth | 18.25 | 12,600 | 18,900 | 20.1 |
| Henson Creek (at Oxon Hill, Md.) | 16.7 | 36,000 | | 18.4 |
| Piscataway Creek at mouth | 70.4 | 19,700 | 29,500 | 35.1 |
| Hunting Creek at mouth | 46.3 | 12,900 | 19,300 | 43.0 |
| Dogue Creek at mouth | 17.9 | 6,200 | 9,300 | 16.6 |
| Turkey Run at mouth | .97 | 1,800 | 2,700 | 1.15 |
| Sideburn Branch at mouth | 3.34 | 6,200 | 9,300 | 3.32 |
| Accotink Creek at mouth | 50.9 | 35,100 | 52,650 | 64.4 |
| Accotink Creek (near Annandale, Va.) | 23.6 | 17,800 | | 25.8 |
| Pohick Creek at mouth | 35.4 | 24,400 | 36,600 | 31.3 |
| Fourmile Run (at Alexandria, Va.) | 14.4 | 4,000 | 6,000 | 14.8 |
| | | | TOTAL 1,030,300 | |

Total sediment load contributed by tributaries equals 710,200.

TABLE IV

CONCLUSIONS

1. The primary sources of sediment in the Washington Metropolitan area are residential, institutional and highway construction sites, sand and gravel mining operations and extreme erosion caused by intense runoff from parking areas, man-made stream channels, and storm sewers.

2. Urban and Suburban development are known to significantly affect sediment loads in the Potomac River Basin.

3. Suburban areas in all parts of the Washington, D. C. area are growing at a remarkable rate.

4. A secondary source of sediment in the Potomac is the process of backwashing of filters at water treatment plants. Three hundred and sixty-four tons of sediment are discharged yearly by the Dalecarlia Water Treatment Plant alone. The magnitude of this problem is relatively insignificant when compared to the total sediment load transported by all sources.

RECOMMENDATIONS

1. Extensive sediment studies should be conducted on streams and discrete sediment sources in the Potomac River Basin. All sources, causes and amounts of sedimentation should be documented.

2. Regulatory measures must be adopted and enforced to control erosion from construction areas. [1]

3. Where urbanization has caused severe flooding, construction of holding structures or other flow control devices should be considered.

4. Backwashing practices at water treatment plants should be evaluated and procedures implemented to reduce substantially this source of silt pollution.

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1. Counties of Fairfax, Montgomery, and Prince Georges, and Washington, D. C. currently have sediment control programs.

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